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Notes on some Japanese smut fungi. 6. *Macalpinomyces arundinellae-setosae* and *Sporisorium doidgeae* newly recorded, and new hosts of *Anthracoidea microsora*

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Abstract—*Macalpinomyces arundinellae-setosae,* known only from Australia and Thailand, is reported for the first time from Japan, on a new host plant, *Arundinella hirta. Sporisorium doidgeae* is also recorded as a new species for Japan, on *Capillipedium parviflorum. Carex pisiformis, C. sachalinensis* var. *iwakiana,* and *C. stenostachys* var. *stenostachys* are new host plants of *Anthracoidea microsora,* a species endemic to Japan.

Key words—*Anthracoideaceae, Cyperaceae, Poaceae,* taxonomy, *Ustilaginaceae*

Introduction

A taxonomic revision of specimens of smut fungi, as part of ongoing study of the smut fungi in Japan (Denchev & Kakishima 2000a, b, 2007; Denchev & al. 2000, 2006, 2011, 2013, 2015; Denchev & Denchev 2014), revealed two new fungal records for this country (*Macalpinomyces arundinellae-setosae* and *Sporisorium doidgeae*) and three new host plants of *Anthracoidea microsora: Carex pisiformis, C. sachalinensis* var. *iwakiana,* and *C. stenostachys* var. *stenostachys.*

Materials & methods

Specimens from the fungal dried reference collections of Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Ibaraki (TSH), and the Kanagawa Prefectural Museum of Natural History, Odawara, Kanagawa (KPM), and infected dried plants from the Herbarium of Okayama University of Science, Okayama (OKAY) were examined under light microscope (LM) and scanning electron microscope (SEM). For LM observations and measurements, spores were mounted in lactoglycerol solution (w : la : gl = 1 : 1 : 2) on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. The spore measurements are given in the form: min–max (extreme values) (mean ± 1 standard deviation). For SEM, spores were attached to specimen holders by double-sided adhesive tape and coated with gold (in JEOL JSM-5510 and JEOL JSM-6390) or platinum-palladium (in JEOL JSM-7600F) in an ion sputter. The surface structure of spores was observed and photographed at 5 or 10 kV accelerating voltage using a JEOL JSM-5510 (Fig. 2), JEOL JSM-7600F (Fig. 5), and JEOL JSM-6390 (Figs 7–9) scanning electron microscopes. The height of warts was measured in SEM. The type of spore ornamentation, as seen by SEM, is in accordance with Denchev & al. (2013). The descriptions of smut fungi given below are based entirely on the specimens examined.

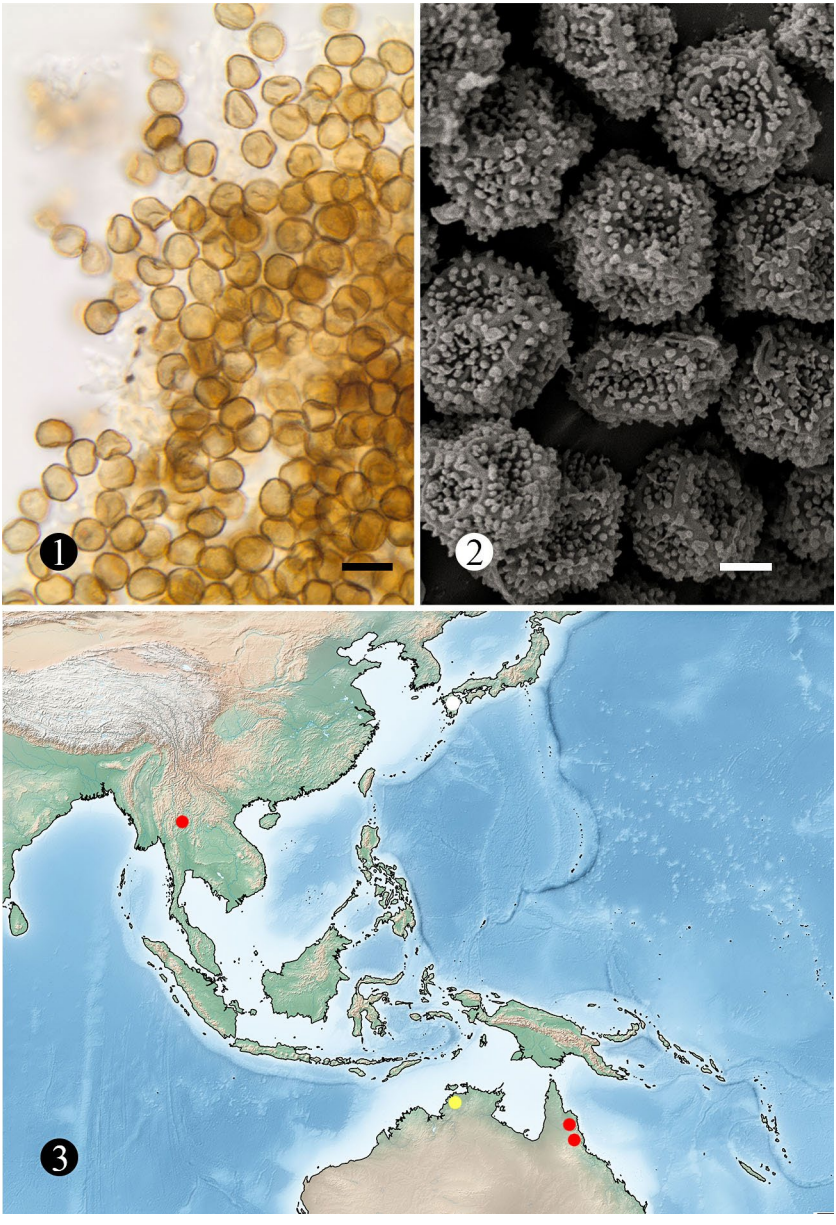
Taxonomy

Macalpinomyces arundinellae-setosae R.G. Shivas & Vánky, Mycol. Balcan. 2: 101, 2005. Figs 1, 2

Sori in some ovaries of the inflorescence, 3–8 × 0.5–0.8 mm, cylindrical, protruding beyond the spreading glumes; initially covered by a fragile, yellow-brown peridium that ruptures irregularly from its distal part, exposing the powdery, dark brown mass of spores and sterile cells. Sterile cells in irregular groups, 6–10 µm long, hyaline; wall 0.5–0.8 µm thick, smooth. Spores subpolyhedral, subglobose, broadly ellipsoidal, globose or ovoid, 6.5–9(–9.5) × 6–8(–9) µm (8.1 ± 0.6 × 7.3 ± 0.5 µm; n = 100), medium yellow-brown; wall more or less evenly thickened, 0.5–0.8 µm thick, in LM verruculose, spore profile usually slightly affected. In SEM moderately verruculose-echinulate, ornaments up to 0.4 µm high.

Specimen examined—On *Arundinella hirta* (Thunb.) Tanaka: **JAPAN, Kyushu, Kumamoto Prefecture,** Yamaga-shi, Kamoto, 3 November 1906, leg. K. Yoshino (TSH S-803, as *Sorosporium arundinellae* on *Arundinella anomala* Steud.).

Comments—*Sorosporium arundinellae* Syd. & P. Syd. was described from Japan on the same host plant, *Arundinella hirta* (Sydow & Sydow 1901), and was subsequently included in some taxonomic treatments of the smut fungi in Japan (e.g. Ito 1936, Kakishima 1982) and China (e.g. Wang 1964, Guo 1990). This species was reduced to a synonym of *Ustilaginoidea arundinellae* Henn.



Figs 1–3. ***Macalpinomyces arundinellae-setosae*** on *Arundinella hirta.* 1. Spores in LM; 2. Spores in SEM. Scale bars: 1 = 10 µm, 2 = 2 µm. 3. Geographic distribution of *Macalpinomyces arundinellae-setosae:* white circle – on *Arundinella hirta,* red circles – on *A. setosa,* yellow circle – on *A. nepalensis* (generated with SimpleMappr, Shorthouse 2010).

(*Clavicipitaceae*) by Ling (1951: 106 & 1953: 344; confirmed by Vánky 2011). We studied an isotype of *Sorosporium arundinellae* (Saitama Pref., Saitama-shi, Omiya, 20 November 1899, leg. T. Nishida, TSH S-4590) and confirm that it is not a smut fungus.

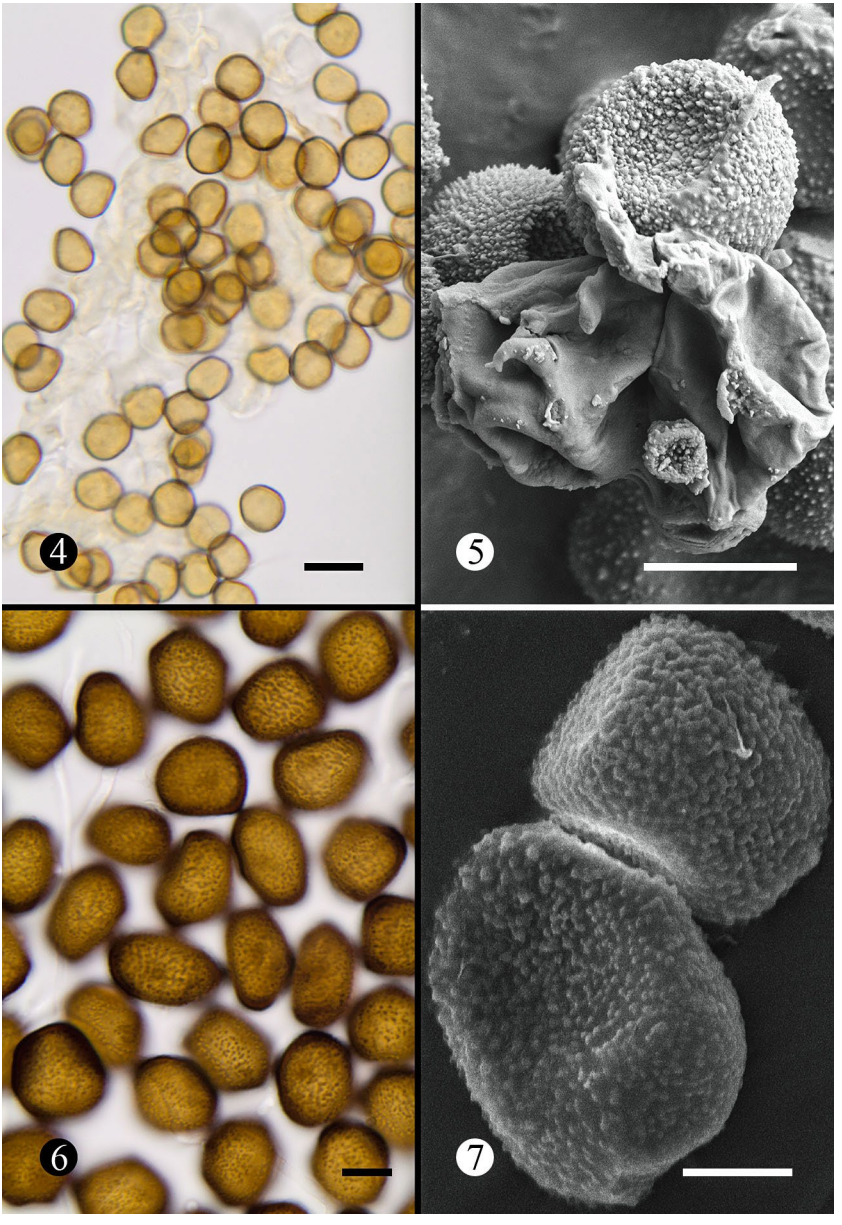
Macalpinomyces arundinellae-setosae is reported here for the first time from Japan, on a new host plant, *Arundinella hirta.* This smut fungus is known on *Arundinella setosa* Trin. from Queensland, Australia, and Thailand (Shivas & Vánky 2005, Shivas & al. 2007, Vánky & Shivas 2008), and on *A. nepalensis* Trin. from the Northern Territory, Australia (Vánky & Shivas 2008, Shivas 2010) (Fig. 3).

Sporisorium doidgeae (Zundel) Langdon & Full., Mycotaxon 6: 452, 1978. Figs 4, 5

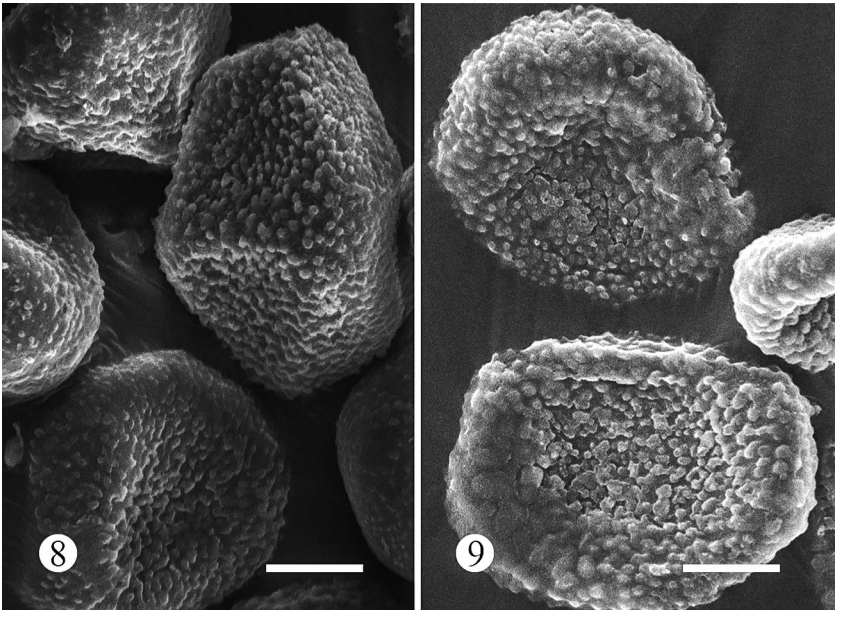
Sori variable, destroying the whole inflorescence, or some branches of the inflorescence, or some racemes, or groups of spikelets, or single spikelets. Accordingly, the sori can be cylindric, irregularly branched or compound, often with intact inflorescence branches or groups of spikelets; when destroying the whole inflorescence up to 4 cm long, partly concealed by the uppermost leaf sheath, when destroying single spikelets 1.5–2.5 × 0.7–1 mm; initially covered by a fragile, dark brown or ferrugineous brown peridium which later flakes away exposing a single or branching columella with shallow longitudinal furrows, surrounded by semi-agglutinated to powdery dark reddish brown mass of spores and sterile cells. Sterile cells in irregular groups or in chains, subglobose, collapsed, 7–11(–13) µm long, hyaline or subhyaline; wall 0.5–0.8 µm thick. Spores subglobose, globose, slightly irregular, broadly ellipsoidal or ovoid, rarely ellipsoidal, (7.5–)8–10(–11.5) × (7–)7.5–9.5(–10.5) µm (9.2 ± 0.6 × 8.3 ± 0.6 µm; n = 100), medium reddish brown; wall more or less evenly thickened, 0.5–0.7(–0.9) µm thick, minutely echinulate, spore profile not affected or very slightly affected. In SEM minutely echinulate, spinules up to 0.2(–0.3) µm high; densely punctate between the spinules.

Specimen examined—On *Capillipedium parviflorum* (R. Br.) Stapf: **JAPAN, Okinawa, Okinawa Prefecture,** Naha-shi, Shuri, 25 April 1953, leg. N. Hiratsuka (TSH S-3329, as *Ustilago* sp. on *Bothriochloa parviflora* (R. Br.) Ohwi).

Comments—Further information about smut fungi on *Capillipedium, Bothriochloa,* and *Dichanthium* is given in Vánky (2004) and Denchev & al. (2016). *Sporisorium doidgeae* is distributed in Asia (Pakistan, India, and China), Australia, and Africa (Ethiopia, Zimbabwe, and South Africa) (Vánky & Shivas 2008, Vánky 2011, Vánky & al. 2011). It is reported here for the first time from Japan.



Figs 4–7. ***Sporisorium doidgeae*** on *Capillipedium parviflorum*. 4. Spores and sterile cells in LM; 5. Spores and sterile cells in SEM. ***Anthracoidea microsora*** on *Carex pisiformis*. 6. Spores in LM; 7. Spores in SEM. Scale bars: 4, 6 = 10 µm, 5, 7 = 5 µm.



Figs 8, 9. ***Anthracoidea microsora*** spores in SEM. 8. On *Carex sachalinensis* var. *iwakiana;* 9. On *Carex stenostachys* var. *stenostachys.* Scale bars = 5 µm.

Anthracoidea microsora (Syd.) Kukkonen,
Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo" 34(3): 55, 1963. Figs 6–9

Spores moderately verruculose to verrucose, warts 0.4–0.6 µm high, affecting the spore profile (for detailed description and illustrations of this species, see Denchev & al. 2013).

Specimens examined—On *Carex pisiformis* Boott (det. T. Katsuyama): **JAPAN, Honshu, Kanagawa Prefecture,** Odawara, Iryuda, 14 May 2010, leg. C. Akahori & S. Sasaki (KPM-NC 0017281, as *Anthracoidea caricis*); 25 May 2013, leg. K. Otsubo (pers. collection). —On *Carex sachalinensis* var. *iwakiana* Ohwi (det. H. Shimizu): **JAPAN, Honshu, Nagano Prefecture,** Kita-saku-gun, Miyota, Terasawa, 36°20′47″N 138°29′40″E, alt. 990 m, 10 June 2013, leg. H. Shimizu (OKAY-Shimizu2281). —On *Carex stenostachys* Franch. & Sav. var. *stenostachys* (det. T. Masaki): **JAPAN, Honshu, Okayama Prefecture,** Maniwa-shi, Sugatani, Utsukushi-mori, 35°08′04″N 133°41′05″E, alt. 636 m, 2 June 2013, leg. T. Masaki (OKAY-23849).

Comments—*Anthracoidea microsora* is endemic to Japan and known to infect the following sedges: *Carex alterniflora* Franch. var. *alterniflora* [≡ *C. sachalinensis* var. *alterniflora* (Franch.) Ohwi], *C. duvaliana* Franch. & Sav., *C. fernaldiana* H. Lév. & Vaniot [≡ *C. sachalinensis* var. *fernaldiana* (H. Lév. & Vaniot) T. Koyama], *C. stenostachys* var. *cuneata* (Ohwi) Ohwi &

T. Koyama, and *C. tenuinervis* Ohwi (Denchev & al. 2013). Three additional host plants, *C. pisiformis, C. sachalinensis* var. *iwakiana,* and *C. stenostachys* var. *stenostachys,* are reported here. A specimen reported by Akahori (2011) as *Anthracoidea caricis* on *Carex pisiformis* was re-examined and re-identified as *A. microsora.* The specimens examined here matched closely the description of *A. microsora* in the monograph of *Anthracoidea* in Japan (Denchev & al. 2013).

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